REMARKS

The Examiner is thanked for consideration of this application. This is in response to the issues raised in the office action.

The title has been amended as above.

Reference to the specification is based on the replacement pages submitted in the parent PCT/US06/013681.

Regarding 2D, page 27, paragraph 183 of the replacement pages described FIG. 2D as one embodiment among several embodiments of cross-sectional shapes probes.

The brief description of the drawings is provided on pages 7-21.

Regarding the rejection based on 35 USC 112-first paragraph, it is submitted that extensive discussion of various methods to make probes are described in the application, for instance, at pages 44-85 and in the figures. It is understood that the law does not require that a patent specification be equivalent to a production specification. I submit that to one of ordinary skill in the art can produce structures according to the claims based on the teachings in my application.

Turning to the prior art rejections, I submit that the claims are not anticipated or unobvious in view of any of Takazawa 6930307, Hidaka 6555362 or Watanabe 20020132500, alone or in any combination.

The invention of the scanning tunneling microscope, STM, in 1981, and related instruments, including the atomic force microscope, AFM, and the general scanning probe microscope, SPM, caused early excitement about its possible use to sequence DNA. Numerous proposals, research efforts and investments were dedicated to this application and voluminous publications scientific and patents were produced. All of these efforts, prior art, relied on producing and controlling atomically sharp probes of about 1 nm dimension. Thirty years have passed and none of the efforts produced positive results. Other paths have been taken that succeeded in sequencing the whole human genomes, as well as other plant and animal species, launching a multibillion dollar industry that is advancing humanity.

The object of the present invention is teaching solutions to problems encountered by prior art efforts. The prior art problems emanated directly from the use of sharp probes with symmetrical circular cross section , in particular, the physical scanning by the probe of a surface in the x and y directions and the movement of the probe above said surface on which lies the object or sub-object to be analyzed by said probe.

The present invention is related to making and using a probe that does not have a symmetrical circular cross section. Instead, the inventive probe has a vary large aspect ratio. Par. [0171] states:

> ***"The ratio of w to t may be, for example, on the order of about 5:1. 10:1, 10s to 1,100 to 1, 100s to 1,1000 to 1,10,000 to 1, or greater depending on the desired application."***

This avoids completely the problems (explained below) associated with the need by prior art for the scanning motion in the x and y direction in order to first locate the specimen, then image it, and finally sequence it. The ultra-large aspect ratio of the inventive probe enables it to easily locate the object, without x-y motion of the probe. Instead, the inventive probe moves only up and down to land directly on the object, without missing the object and without landing error.

The references cited by the examiner, Takazawa, Hidaka and others, are no different from all other prior art that use circular cross section probes. Since none of them uses ultra-large aspect ratio probes they failed to avoid the problems. My extensive research discovered these prior art problems and why their efforts have been abandoned.

The following are prior art problems (based on STM or SPM) that lead to the need for ultra-large aspect ratio probe of the present invention:

1. The STM tip has to be ~0.5 nm in order to resolve directly each base pair which has been a challenge.
2. The DNA sample needs to be accurately imaged first to locate it with sub-nanometer resolution and wide dynamic range. For DNA lengths of 1-30 mm, this takes a long time. This step is susceptible to tip crashes since the feed-back loop is closed. Any noise will cause instability and crash the tip or register errors in the position.
3. After the first imaging step, a second step of recognizing (sequencing) the nucleotides is needed. Since the invention of the STM all attempts to accomplish this step have failed. This step is even more difficult than the imaging step because it requires three feed back loops (one for each of x, y and z coordinates) to be closed to maintain the tip position (hover) on the sample. Three high voltage piezo translators (for x, y and z) emit noise to cause instability of the feed back look and crash, ruining the sample and the instrument.
4. Even if crashes are some-how avoided, the imaging and recording steps are taken in noisy environments due to the energized electronics and the three high-voltage piezo-translators. Solving this noise problem and minimizing errors will increase the sequencing time, significantly slowing down the sequencing and adds to the system cost.
5. Even if the tip does not crash, during the imaging mode, the ultra-sharp tip is energized with a voltage between 0.2 to 1 V. In nano-scale, the electric fields at

the tip exert strong electrostatic forces (attractive or repulsive) on the sample to cause it to move making it difficult to sense its identity.

6. The strong electrostatic force during the imaging and recognition steps will attract contaminants to the tip, limiting the life cycle unless ultrahigh vacuum environment is used, slowing down sequencing and adding more cost.
7. One possible strategy to recognize the nucleotide is using inelastic tunneling spectroscopy. This requires ultra-low noise environment and cooling to low temperature to minimize thermal noise.
8. The above difficulties with a single tip, precludes taking advantage on N STM tips sequencing directly the same DNA sample. It would be a tremendous challenge aligning N 0.5 nm tips in x-y-z coordinates.

The present invention alleviates all of these by first making a probe having a width to thickness ration much larger than 1, and then use it in an inventive scanning system to sequence ultra-long DNA and other objects.

Respectfully, applicant traverses Examiner's rejection in view of Takazawa invention that focuses on the central point of making circular cross section carbon nano tubes for use in STM or SPM system like all others that failed due to items 1-8 above.

Applicant also traverses the rejection in view of Hidaka for the same reasons above and specifically for making the central point of invention the attraction of the specimen by the probe which lead directly to the problems 3-5 above. This prior art deals with instrumentation issues rather than making probes, let alone probes of ultra-high aspect ratio.

The Watanabe reference does not deal with making probes, instead, it deals with the application of probes having circular cross sections.

Claim 13 has been amended to recited "width" rather than "length," for instance, as described with reference to FIG. 1A. The structure of the probe comprises a body having an edge, the edge having a thickness less than a relevant dimension of one of said sub-objects, and a width substantially greater than a relevant dimension of one of said sub-objects.

Claim 15 has been amended to recite the thickness rejection and to correct the issue under 35 USC 112-second paragraph. The structure of the probe includes a body having an analyzing region, the analyzing region having a thickness dimension less than a relevant dimension of said object and a width substantially greater than a relevant dimension of one of said objects.

The above addresses the independent clams and the claims are patentable based on the above arguments.

In addition, I wish to address other issues raised.

In regards to claims 35-37 and 43-44, Takazawa does not teach a body formed of a single layer or a predictable number of layers derived from a lamellar material or graphene because the central point of Takazawa is a probe with a circular cross that is believed to be made of a graphene structure rolled into a cylindrical probe. It is does not use the edges lamellar material layers such as graphene to form a probe with ultra-large aspect ration.

In addition, claims 41 and 49 are rejected based on the above combination and also in view of Lieber et al. 6159742. I respectfully disagree because of the use of circular cross section probes in systems that suffer from all the limitations of prior art scanning probes for sequencing.

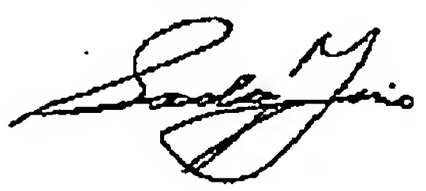
In view of the above, Applicant respectfully requests allowance of the claimed invention.

Previously withdrawn claims 16-18 are now canceled. New claims 50-53 are presented, supported by paragraph [171] of the specification (the replacement pages submitted in the parent PCT/US06/013681).

Conclusion:

The Examiner is invited to call the Inventor at the below telephone number to discuss any issues or for additional explanation.

Respectfully Submitted,



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